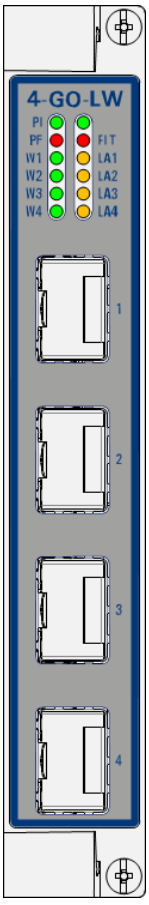
User Manual

Installation
Dragon PTN
Interface Module PTN-4-GO-LW



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1. INTRODUCTION

1.1 General

This document is valid as of Dragon PTN Release 4.3DR.

This document describes the 4-GO-LW interface module (=IFM) which provides four 1Gbps LAN/WAN SFP ports on the front panel (LAN = Local Area Network; WAN = Wide Area Network). Each individual port can be configured as either LAN or WAN port via HiProvision (=Dragon PTN Management System). By default, each port is configured as WAN port. 4-GO-LW refers to '4 ports – Gigabit Optical port – LAN WAN'.

Verify the 'Dragon PTN Bandwidth Overview' manual (Ref. [100] in Table 1) to see in which node and IFM slot this IFM can be used. This IFM requires an interface adapter kit in core nodes which is not needed in aggregation nodes (see §2.1, Nodes: see Ref. [3], [3b] in Table 1).

Main supported features:

- 4 Gigabit Ethernet SFP Ports: (optical) 1000BASE-X, Smart SFP / (electrical) 1000Mbps;
- Synchronization
  - SyncE;
  - PTP IEEE 1588v2 (=Precision Time Protocol);
- LAN or WAN function selectable per port;
- E-Tree in an Ethernet Service;
- MRP (=Media Redundancy Protocol) Support;
- Layer2: Link Aggregation/LAG.

1.2 Manual References

Table 1 is an overview of the manuals referred to in this manual. '&' refers to the language code, '*' refers to the manual issue. All these manuals can be found in the HiProvision (=Dragon PTN Management System) Help function.

Table 1 Manual References

Ref.	Number	Title
[1]	DRA-DRM801-&-*	Dragon PTN Installation and Operation
[2Mgt]	DRA-DRM830-&-*	HiProvision Management Operation
[2Eth]	DRA-DRM831-&-*	Dragon PTN Ethernet Services
[2Leg]	DRA-DRM832-&-*	Dragon PTN Legacy Services
[2Net]	DRA-DRM833-&-*	Dragon PTN Network Operation
[3]	DRB-DRM802-&-*	Dragon PTN Aggregation Nodes: PTN2210-A, PTN2206-A, PTN1104, PTN2209
[3b]	DRB-DRM840-&-*	Dragon PTN Core Nodes: PTN2215
[4]	DRB-DRM803-&-*	Dragon PTN Switching Module: PTN-CSM310-A/ PTN-CSM540-A
[7]	DRE-DRM819-&-*	Dragon PTN Interface Module: PTN-8-FXS
[8]	DRF-DRM811-&-*	Dragon PTN TRMs (Transmit Receive Modules: SFP, XFP, QSFP+)
[9]	DRA-DRM810-&-*	Dragon PTN General Specifications
[100]	DRA-DRM828-&-*	Dragon PTN Bandwidth Overview

2. MODULE DESCRIPTION

2.1 Front Panel

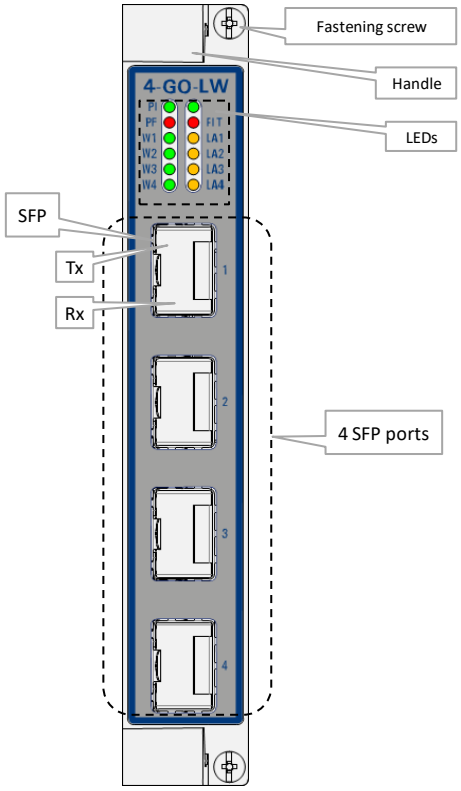

Figure 1 IFM in Aggregation Nodes

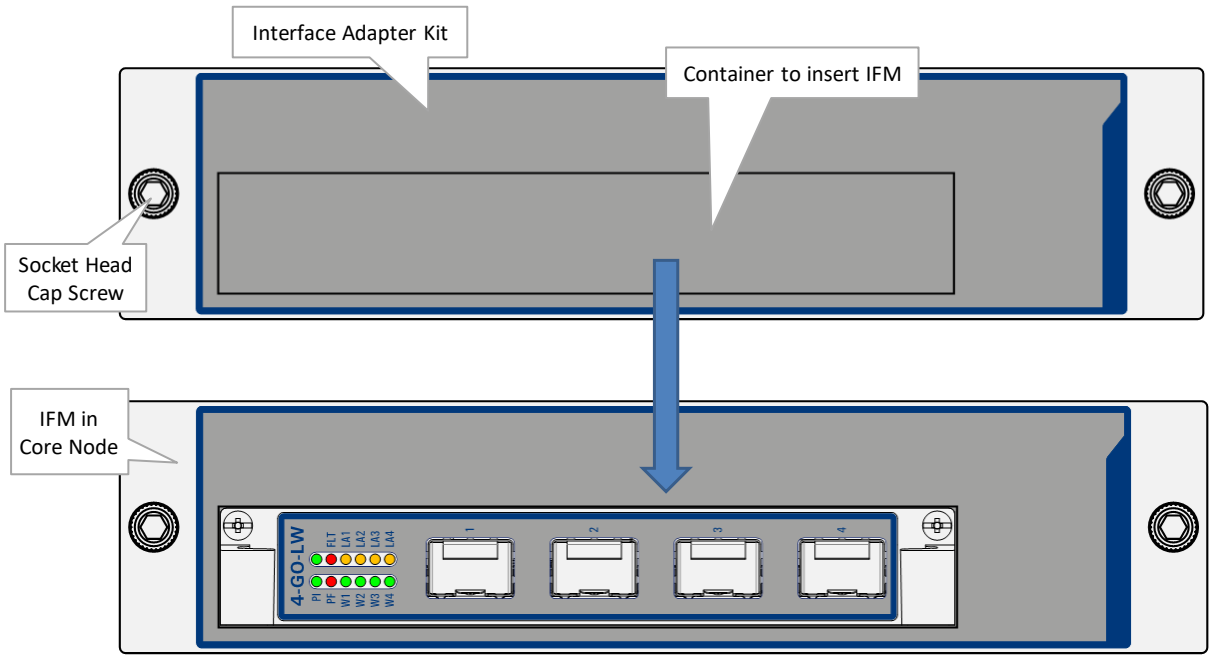

Figure 2 IFM in Core Nodes

2.1.1 Insert/Remove Module into/from Node

See 'Dragon PTN Installation and Operation Manual' Ref.[2].

2.1.2 LEDs

The meaning of the LEDs depends on the mode of operation (= boot or normal) in which the 4-GO-LW module currently is running. After plugging in the module or rebooting it, the module turns into the boot operation, see Table 2. After the module has gone through all the cycles in the table below (=rebooted successfully), the module turns into the normal operation, see LEDs in Table 3.

Table 2 LED Indications In Boot Operation

Cycle	PI	PF	FLT	Spare LED	W[1..4]	LA[1..4]
1	✓	---	Slow blinking	---	---	---
2	✓	---	Fast blinking	---	---	---
3	✓	---	---	---	---	---
4	✓	---	✓	---	✓	---
5	✓	---	---	---	✓	---

✓ : LED is lit / --- : LED is not lit
The sub cycle times may vary.
The entire boot cycle time [1→5] takes approximately 2 minutes.

Table 3 LED Indications in Normal Operation

LED	Color	Status
PI (=Power Input)	Not lit, dark	+12V power input to the board not OK
	Green	+12V power input to the board OK
PF (=Power Failure)	Not lit, dark	power generation on the board itself is OK
	Red	power generation on the board itself is erroneous
FLT (=FauLT)	Not lit, dark	no other fault or error situation, different from PF, is active on the module
	Red	a fault or error situation, different from PF, is active on the module
W<port n°>	Not lit, dark	The link on port<port n°> is a LAN link
	Green	The link on port<port n°> is a WAN link
LA<port n°>	**Normal SFP or RJ45**	
	Not lit, dark	The link on port<port n°> is down
	Yellow lit	The link on port<port n°> is up, no activity
	Yellow blinking	The link on port<port n°> is up, with activity
	Smart SFP (see §2.2.7)	
	Not lit, dark	The port is administratively down or no service programmed on this port
	Yellow blinking	A service is programmed on this port. CAUTION: The link status and link activity to the SDH/SONET network cannot be derived from this LA LED, instead it must be derived from the Smart SFP status/alarms information in HiProvision.

2.1.3 Connectors

This module has 4 Gigabit Ethernet SFP ports that can be either optical or electrical depending on the used SFP:

- Optical SFPs: 1000BASE-X, Smart SFP;
- Electrical SFPs: 1000Mbps;
- SFPs for these ports can be found in Ref. [8] in Table 1;

2.2 Functional Operation

The 4-GO-LW performs following major tasks:

2.2.1 Media Module for Ethernet: Interfacing to a LAN or WAN Network

WAN ports interconnect nodes within the Dragon PTN network (MPLS-TP) whereas LAN ports interconnect the nodes with their applications.

Each Ethernet front port can be configured individually as LAN or a WAN port in HiProvision. By default, each port is configured as WAN port. A LAN port talks Ethernet and a WAN port talks MPLS-TP. As a result, the node can serve as an edge node (or LER = Label Edge Router) where traffic is received on a LAN port, mapped into pseudowire and forwarded to the correct label switched path on a WAN port.

For a configured application service, the node can operate as a:

- LER = Label Edge Router or access node: The node is located on the edge between the LAN and WAN. The node converts Ethernet into MPLS-TP and vice versa;
- LSR = Label Switching Router: The node is fully located in the WAN. The node has no end-points for the configured application service, it only forwards MPLS-TP traffic via label switched paths;

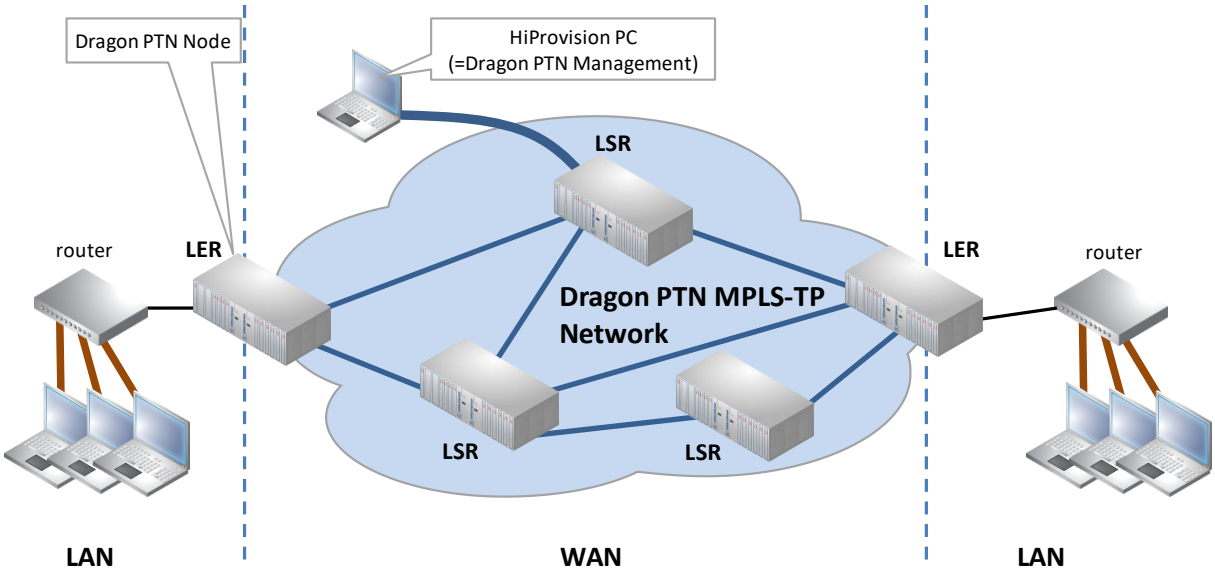

Figure 3 General Example: LAN/WAN

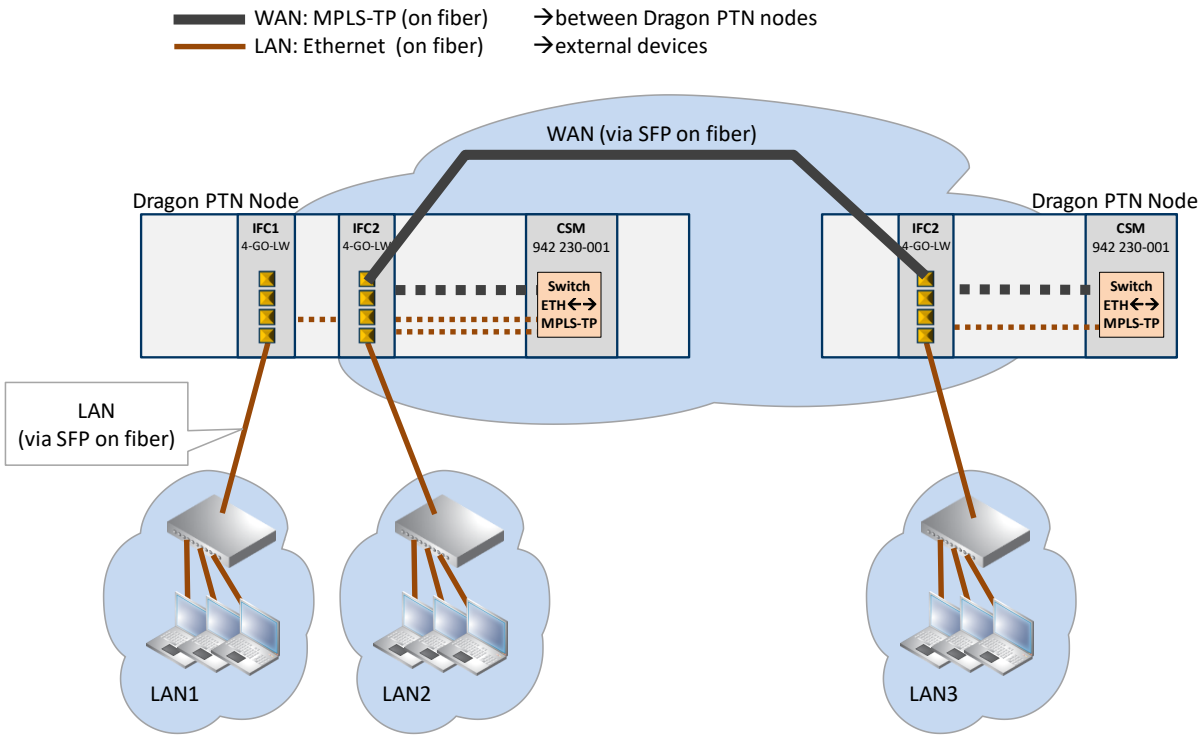

Figure 4 Detailed Example: Interfacing to a LAN or WAN Network

2.2.2 Ethernet Service

a. General

The 4-GO-LW IFM access or end-points communicate over the Dragon PTN network via an Ethernet service. This service must be configured via HiProvision. This service can operate port or VLAN based. An optional E-Tree can be configured as well on this Ethernet service.

b. Port Based / VLAN Based

- Port based: Use this mode if all the traffic on a port must be transported transparently in one and the same service;
- VLAN based (Single VLAN)/VLAN ID: Use this mode if each VLAN (ID) on a port must have its own service. Ethernet packets with the configured VLAN ID will be forwarded in this service, other VLAN IDs and untagged packets will be dropped. This behavior can be overruled by a more advanced VLAN processing in the 'VLAN Tagging/Untagging' feature in HiProvision. This feature also supports VLAN translation which replaces VLAN ID 'x' into VLAN ID 'y'.
- VLAN based (Multi VLAN)/QinQ VLAN ID (can only be used when L2/L3 IFM ports are included in the service): With QinQ, a VLAN based service can carry multiple VLANs instead of just one. QinQ is a feature that operates at the back end ports of the L2/L3 IFMs. For incoming traffic on the L2/L3 IFM backend ports (LAN or WAN), this feature adds an outer VLAN (=QinQ VLAN with EtherType 0x8100) around the existing VLANs resulting in double VLAN tagged Ethernet packets. For outgoing traffic on the L2/L3 IFM backend ports (WAN or LAN), the QinQ VLAN is removed. The 4-GO-LW IFM itself is not

able to add/remove the double VLAN tags. It will process incoming double VLAN tagged packets as if it was a single VLAN tagged packet meaning that only the outer VLAN will be processed. Detailed examples with a mix of all these IFMs can be found in Ref. [2Eth] in Table 1. A switch that supports QinQ should be connected to the 4-GO-LW ports to process double VLAN tagged packets.

c. E-Tree

An E-Tree is a rooted (not routed) point-to-multipoint partial service within a programmed Ethernet service. E-Tree can be used as a security precaution to separate different customers (=leafs) using the same Ethernet service while accessing one or more ISPs (=roots).

When an E-Tree is used, each service endpoint is designated as either **leaf** or **root**. A leaf can only communicate with a root. A root can communicate with all the roots and leafs.

2.2.3 Voice Service

The 4-GO-LW IFM ports can be configured in the Ethernet part of the Voice service. See Ref. [2Leg] and Ref.[7] in Table 1 for more information on the Voice service.

2.2.4 I/O with the Central Switching Module (=CSM)

The 4-GO-LW module receives traffic (Ethernet or MPLS-TP) via its front panel ports and forwards this to the CSM via the backplane. The CSM does all the processing on this data (synchronization, CRC checks, conversions, switching…). The resulting data will be forwarded via the backplane to one of the IFMs in the node.

2.2.5 Synchronization / Clock Distribution / Network Timing

The Dragon PTN network provides a number of mechanisms to perform synchronization / clock distribution / network timing. The CSM makes sure that all the included IFMs in the node are synchronized. See the table below for an overview of the mechanisms that are supported on the 4-GO-LW module.

It means that the front ports of the 4-GO-LW module can be used to recover a clock from an incoming data stream and redistribute this clock via an outgoing datastream;

Table 4 Synchronization / Clock Distribution / Network Timing Overview

Mechanism	Domain	What is Synchronized?	Purpose
SyncE	Network wide	Clock Frequency	Distribute a synchronous clock, based on a PRC (=Primary Reference Clock), network wide over all the nodes that need it.
PTP IEEE 1588v2	Network wide	Timestamping	A protocol to synchronize real-time clocks (timestamping) in Dragon PTN network elements and/or connected devices.

a. SyncE (=Synchronous Ethernet)

See the manuals in Ref.[2Net] and Ref.[4] for more detailed information.

b. PTP IEEE 1588v2 (=Precision Time Protocol)

See the manual in Ref.[2Net] for more detailed information.

2.2.6 MPLS-TP Compliancy

See the CSM manual in Ref.[4].

2.2.7 Smart SFP

Smart SFP is a hot-pluggable optical transceiver that converts incoming STM/OC frames from a fiber-optic SDH/SONET network into Ethernet frames at the 4-GO-LW front port 1 or vice versa for outgoing frames. As a result, Dragon PTN allows to transparently transport synchronous digital bit streams from an SDH/SONET network via the 4-GO-LW IFMs.

Smart SFPs must be used in a point-to-point port based Ethernet service over Dragon PTN.

The Smart SFP has an optional security feature onboard which allows to secure the point-to-point connection to only two dedicated MAC addresses. This can be done via setting the Destination MAC Address in HiProvision for the Smart SFPs. Furthermore, the Smart SFPs need some extra Quality of Service settings in HiProvision, see Ref. [2Leg] in Table 1.

For clocking/Synchronisation, SyncE must be configured in the nodes that have Smart SFPs plugged in.

Smart SFPs also generate appropriate alarms, e.g. Loss of Signal, Loss of Frame etc.

NOTE: Smart SFP is also called TSoP (Transparent Sonet/SDH over Packet).

NOTE: The supported Smart SFPs and speeds can be found in Ref. [8] in Table 1.

NOTE: SFPs are typically used on WAN ports whereas Smart SFPs are used on LAN ports.

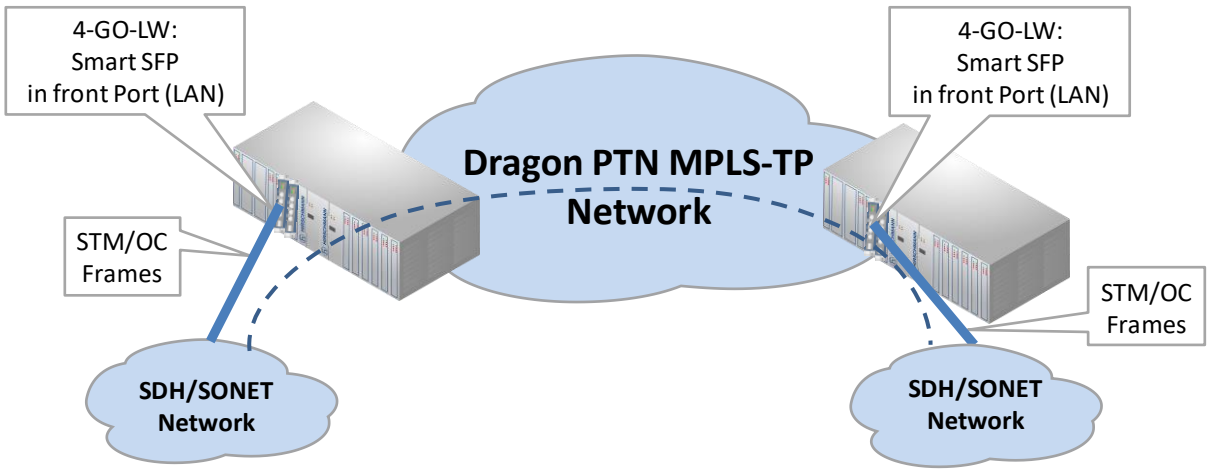

Figure 5 SDH/SONET over Dragon PTN via Smart SFPs

2.2.8 Storm Control on Ethernet LAN Port

NOTE: Storm Control is not relevant/supported on WAN Ports;

A traffic storm is the growing of excessive network traffic due to Ethernet packets flooding the LAN. Such a storm can for example occur because of a data loop in the network due to no or misconfiguration of MSTP. These storms degrade the network performance and must be avoided whenever possible.

The storm control feature:

- is an extra protection against these traffic storms;
- can be configured on the IFM ports;
- limits the amount of unlearned received data (Unicast, Broadcast, Multicast) on the LAN port ingress or input side;
- limits the amount of transmitted data (all data) on the LAN port egress or output side;
- Data that exceeds the configured limitations will be dropped. As a result, a possible data storm cannot overload the node processor or the node will limit outgoing data.

See Ref. [2Eth] in Table 1 for more configuration information in HiProvision.

2.2.9 BPDU Guard on Ethernet LAN Port

NOTE: BPDU Guard is not relevant/supported on WAN Ports;

BPDU Guard (=Bridge Protocol Data Unit) is a LAN port property or feature that:

- shuts down the LAN port when a BPDU packet enters this port;
- sends out dummy BPDU packets.

As a result, this feature or IFM:

- protects the network against possible loops created via this IFM, although this IFM does not support MSTP;
- protects a running MSTP protocol somewhere else in the Dragon PTN network from external MSTP influences via this LAN port, e.g. root bridge protection etc...

See Ref. [2Eth] in Table 1 for more configuration information in HiProvision.

2.2.10 MRP (=Media Redundancy Protocol) Support

The MRP is a protocol (IEC 62439-2) especially designed for industrial applications which need a predictable fail-over time. This protocol can only be used in a ring-topology network and makes sure that the ring network stays loop-free. MRP does in ring networks what spanning tree does in meshed networks but with much faster convergence times. The ring has one selected MR Manager (MRM) and a number of MR Clients (MRC). The two Dragon PTN nodes act as MRC. See Ref. [2Eth] in Table 1 for more configuration information in HiProvision.

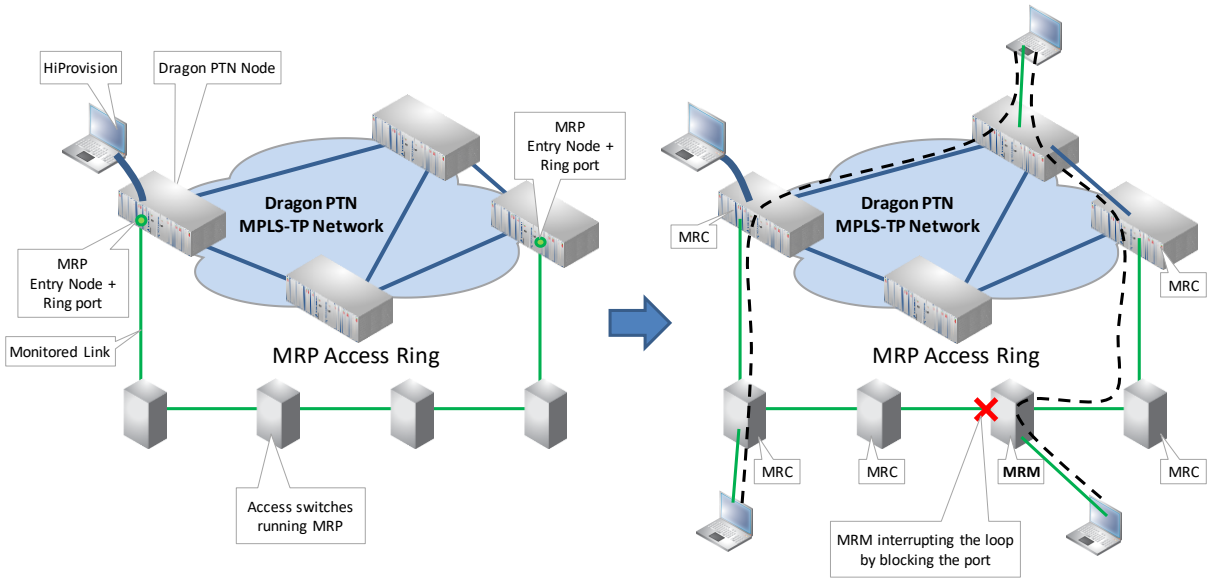

Figure 6 MRP: General Example

2.2.11 Layer2: Link Aggregation/LAG (=Link Aggregation Group)

Link Aggregation is the bundling (=aggregation) of multiple physical Ethernet links between a source and destination side into one combined logical Ethernet link. A LAG is a combination of multiple Ethernet LAN ports within one logical port group, maximum 8 ports per LAG and 8 LAGs per node. The Link Aggregation is the communication between two LAGs. E.g. one LAG in one Dragon PTN node and the second LAG in a third party switch/application. For 1G ports, all the ports of the source and destination LAG must be in autonegotiation. On the Dragon PTN side, ports with the same speed and linked to the same switch ASIC (CSM, L2 or L3) can be added to the same LAG. Each bullet shows the possible LAG ports per switch ASIC:

- CSM: all Ethernet IFM ports (4-GC-LW, …) of the same speed in the same node;
- L2: all 6-GE-L IFM ports;
- L3: all 9-L3A-L / 9-L3EA-L IFM ports of the same speed;

NOTE: Example: Ports in different nodes can not be added to the same LAG because they are linked to different switch ASICs. CSM (4-GC-LW, …), L2 and L3 ports in a same node can not be added to the same LAG because they are linked to different switch ASICs.

NOTE: LAG on WAN ports and L2/L3 back end ports is not supported.

The resulting combined logical link:

- has at least the bandwidth of one individual link (1 Gbps bandwidth for a 1G port, 10 Gbps for a 10G port), but can have more bandwidth if both conditions below are met:
  - multiple streams from different MAC addresses are streamed over the LAG;
  - the LAG algorithm loadshares these streams over different links within the LAG;
- offers loadsharing based on the source and destination MAC addresses;
- offers redundancy in case one of the individual links should fail.

LAG is configured in HiProvision. See Ref. [2Eth] in Table 1 for more configuration information in HiProvision.

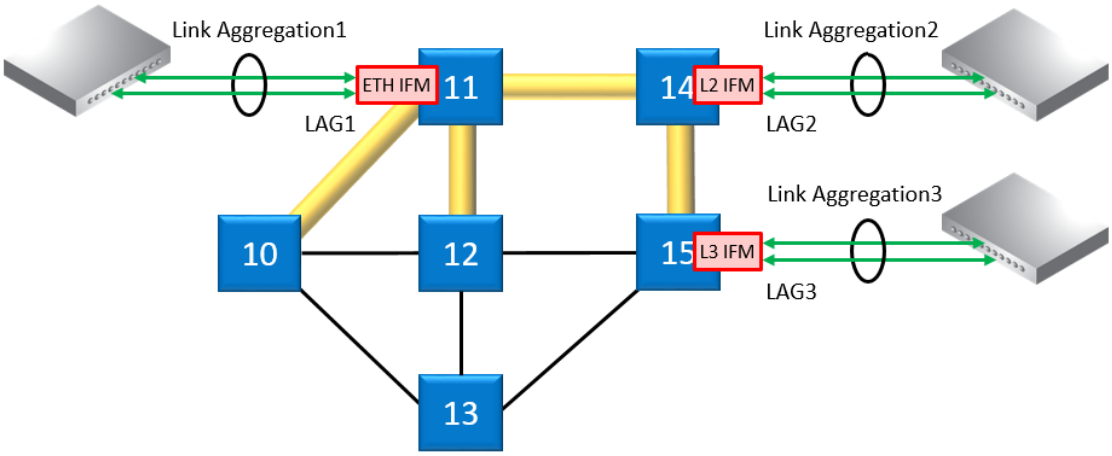

Figure 7 Link Aggregation and LAGs

2.3 Onboard Interfaces

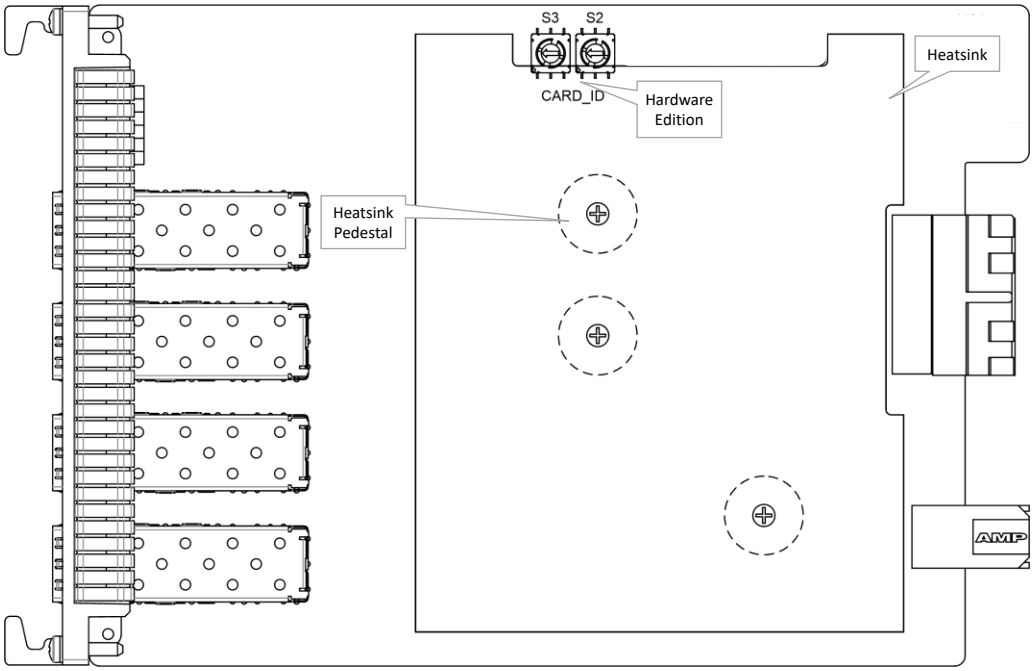

Figure 8 4-GO-LW: Side View

2.3.1 Straps

No straps on the board.

2.3.2 Rotary DIP Switches

a. Hardware Edition

The Hardware Edition (labeled as CARD_ID) is set in decimal code using rotary switches S2 to S3 (S3 = most significant). It can be read out as well via HiProvision, see Ref. [2Mgt] in Table 1. This edition has been factory set and MUST NOT BE CHANGED!

Example: Setting S3='0' and S2='5' indicates Hardware Edition '5' (dec).

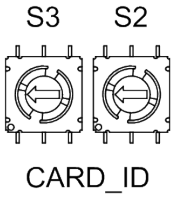

Figure 9 Hardware Edition

3. MODULE SPECIFICATIONS

3.1 General Specifications

For general specifications like temperature, humidity, EMI... see Ref.[9] in Table 1.

3.2 Other Specifications

Table 5 Other Specifications

Description	Value
Weight	0.26 kg / 0.6 lb
MTBF	170 years at 25°C/77°F
Power Consumption	7.5 W (measured at 25°C/77°F, with data transport)
Module Size	width: 20.32 mm / 0.8 inches height: 126 mm / 4.96 inches depth: 195 mm / 7.68 inches

3.3 Ordering Information

- PTN-4-GO-LW: 942 236-002;
- Interface Adapter Kit for Core Nodes: 942 237-007.

4. ABBREVIATIONS

ASIC	Application-Specific Integrated Circuit
BPDU	Bridge Protocol Data Unit
CE	Conformité Européenne
CSM	Central Switching Module
EFM-F	Ethernet in the First Mile Over Point-to-Point Fiber
EMI	Electromagnetic Interference
FLT	Fault
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IETF	Internet Engineering Task Force
IFM	InterFace Module

ISP	Internet Service Provider
LAG	Link Aggregation Group
LAN	Local Area Network
LER	Label Edge Router
LSR	Label Switching Router
LVD	Low Voltage Directive
MIB	Management Information Base
MRC	Media Redundancy Clients
MRM	Media Redundancy Manager
MRP	Media Redundancy Protocol
MSTP	Multiple Spanning Tree
MTBF	Mean Time Between Failures
PD	Powered Device
PF	Power Failure
PI	Power Input
PSC	Protection State Coordination
PSE	Power Source Equipment
PSU	Power Supply Unit
PTN	Packet Transport Network
PTP	Precision Time Protocol
SNMP	Simple Network Management Protocol
SyncE	Synchronous Ethernet
TSoP	Transparent Sonet/SDH over Packet
WAN	Wide Area Network